September 12, 2003

Acquisition

Air Force Transition of Advanced Technology Programs to Military Applications
(D-2003-132)

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Acronyms

ATCs	Applied Technology Councils
ATD	Advanced Technology Demonstration
AFRL	Air Force Research Laboratory
CE	Critical Experiment
IPT	Integrated Product Team
MAJCOM	Major Command
S&T	Science and Technology
TRL	Technology Readiness Level
TTP	Technology Transition Plan

INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
400 ARMY NAVY DRIVE
ARLINGTON, VIRGINIA 22202–4704

September 12, 2003

MEMORANDUM FOR ASSISTANT SECRETARY OF THE AIR FORCE
(FINANCIAL MANAGEMENT AND COMPTOLLER)

SUBJECT: Report on Air Force Transition of Advanced Technology Programs to Military Applications (Report No. D-2003-132)

We are providing this report for review and comment. We considered management comments on a draft of this report when preparing the final report.

DoD Directive 7650.3 requires that all recommendations be resolved promptly. We request that management provide additional comments to Recommendations 1, 3, 4, 5, and 6. Additional management comments should by received by October 14, 2003.

If possible, please send management comments in electronic format (Adobe Acrobat file only) to Audam@dodig.osd.mil. Copies of the management comments must contain the actual signature of the authorizing official. We cannot accept the / Signed / symbol in place of the actual signature. If you arrange to send classified comments electronically, they must be sent over the SECRET Internet Protocol Router Network (SIPRNET).

We appreciate the courtesies extended to the audit staff. Questions should be directed to Mr. Bruce A. Burton at (703) 604-9071 (DSN 664-9071) or Mr. Roger H. Florence at (703) 604-9067 (DSN 664-9067). See Appendix D for the report distribution. Audit team members are listed inside the back cover.

By direction of the Deputy Inspector General for Auditing:

Mary L. Ugone
Acting Director
Acquisition Management Directorate

Office of the Inspector General of the Department of Defense

Report No. D-2003-132 **September 12, 2003**
(Project No. D2002AB-0128)

Air Force Transition of Advanced Technology Programs to Military Applications

Executive Summary

Who Should Read This Report and Why? Science and technology officials in the Office of the Secretary of Defense and the Department of the Air Force should read this report because it evaluates the Air Force's current process for enhancing the likelihood that emerging technology would reach the warfighter.

Background. Congress and DoD officials have voiced concern that technology has not quickly transitioned to the warfighter. In 1999, the Commander of Air Force Materiel Command established the Applied Technology Councils for advanced technology demonstrations to facilitate the transition of technology projects to the warfighter.

The audit examined 30 S&T projects (24 advanced technology demonstrations and 6 critical experiments) funded from the advanced technology development budget subcategory of the FY 2003 Air Force research, development, test, and evaluation appropriation. The 30 S&T projects were valued at $123 million. The 30 S&T projects had additional planned funding of $222 million from FY 2004 through FY 2007.

Results. Although the Applied Technology Councils created a General Officer and executive level review for the advanced technology demonstrations and Air Force Research Laboratory officials perform other management oversight reviews, procedures should be established to strengthen coordination for all advanced technology development funded projects with planned technology recipients. Although most technologies had working-level integrated product teams, the teams had not established charters to identify roles and responsibilities. Half of the technologies had not established a transition plan, most had not established agreements on technology readiness levels and exit criteria with technology recipients, 12 of the working-level integrated product teams had not documented issues and action items, and 8 of the 13 acquisition recipients had not identified the necessary funding for technologies scheduled to transition in FYs 2003 and 2004. Also, the performance appraisal process of S&T officials needs to emphasize technology transitioning as a performance element.

As a result, the Air Force Research Laboratory had planned technology investments of $222 million for technologies included in this review that had not been fully coordinated with the transition recipient. In addition, the Air Force recipients had a $529 million funding shortfall for transitioning technologies scheduled for availability during FYs 2003 through 2005.

Management Comments and Audit Response. The Assistant Secretary of the Air Force (Acquisition) agreed with the report's conclusions on the role of the acquisition program managers and the need to define the relationships and responsibilities between the science and technology managers and the acquisition program managers. However, the Assistant Secretary did not agree that all advanced technology developments need the same level of management controls and made a distinction between advanced technology demonstration programs and critical experiments. As a result, the Assistant Secretary generally nonconcurred with the recommendations pertaining to critical experiments. See the Finding section of the report for a discussion of management comments and the Management Comments section for the complete text of the comments.

Management comments were generally nonresponsive to the report and its recommendations. We believe that there is no significant difference between advanced technology demonstration programs and critical experiments because both use advanced technology development funds. The audit identified improvements that are needed to coordinate technology development with planned technology recipients. Also, technologies are being developed that do not have the necessary technology transitioning funds or for which the transition funds are inadequate. We request that the Assistant Secretary of the Air Force (Acquisition) provide comments on the final report. Comments should be received by October 14, 2003.

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Background

Defense Acquisition. The Deputy Secretary of Defense issued DoD Directive 5000.1, "The Defense Acquisition System," on May 12, 2003. The directive states that science and technology (S&T) programs shall address user needs; maintain a broad-based program spanning all Defense-relevant sciences and technologies to anticipate future needs and those not being pursued by civil or commercial communities; preserve long-range research; and enable rapid successful transition from the S&T base to useful military products. Advanced technology shall be integrated into producible systems and deployed in the shortest time practical. Teaming among warfighters, users, developers, acquirers, technology experts, industry, testers, budgeting officials, and system maintainers shall begin during requirements definition.

Science and Technology Guidance. An affordability task force chartered by the Director for Defense Research and Engineering issued a handbook and the Deputy Under Secretary of Defense for Science and Technology issued a guide to the Military Departments and Defense agencies concerning practices that they believed, if instituted, would assist in transitioning technology. Subsequently, the Under Secretary of Defense for Acquisition, Technology, and Logistics issued a Manager's Guide that reemphasized the issues on technology management cited in the handbook and the guide. In addition, in response to congressional concerns that DoD had not been successful in transitioning technology, the Under Secretary of Defense for Acquisition, Technology, and Logistics issued a report to Congress identifying why technology was not transitioning.

Addressing Affordability in Defense Science and Technology (S&T): A Handbook for S&T Managers. In October 1999, the DoD S&T Affordability Task Force issued a Handbook that stresses the importance of early involvement of all candidate acquisition programs in advanced technology efforts. The Handbook states that early involvement of advanced technology candidate acquisition programs in research development, design, test planning, manufacturing, training, logistics, financing, and contracting are essential to address key issues that lock in a majority of the life-cycle costs of programs. The Handbook states that management tools for ensuring effective technology transitioning include establishing integrated product teams (IPTs), creating IPT charters, identifying quantitative metrics and key exit criteria, and developing a formal transition plan that is officially signed by the technology manager and the "customer" (usually an acquisition community member). Additional management tools include preparing an approved memorandum of agreement or understanding that includes roles and responsibilities of the various participants and a funding strategy, which commits the acquisition community to transition the technology.

Technology Transition for Affordability: A Guide for S&T Program Managers. In April 2001, the Deputy Under Secretary of Defense for Science and Technology issued a Guide to provide S&T managers with strategies to transition technology to the acquisition community. The Guide states that the transition of technology should be timely (get the technology in the hands of the warfighter as soon as possible) and cost-effective (provide the best technology at

the lowest possible cost). The Guide states that a key strategy for transitioning technology is early coordination between the S&T project manager and the receiving acquisition manager to promote a mutual understanding between the two parties.

The Guide states that IPTs should include the S&T product manager, the S&T contractor, the acquisition manager(s) and the respective contractor(s), and test and evaluation representatives. An IPT should be formed early in the life cycle of a technology's development to address key issues that can greatly affect life-cycle cost and the eventual acceptance and implementation of the technology. Issues that the IPT should address include defining and agreeing upon quantifiable metrics, such as cost, performance, and schedule; exit criteria; and the maturity of the technology at transition identified as technology readiness levels (TRLs) (the various levels are described in Appendix B). The Guide states that those issues and others should be agreed upon in formal documentation such as a memorandum of agreement or understanding and technology transition plans.

Manager's Guide to Technology Transition in an Evolutionary Acquisition Environment. In January 2003, the Under Secretary of Defense for Acquisition, Technology, and Logistics reemphasized the guidance issued in the Handbook and Guide was intended to be a source of information to promote collaboration among team members. It provides an overview of the processes, communities, programs, and challenges associated with technology transition.

Under Secretary of Defense for Acquisition, Technology, and Logistics Report to Congress. In June 2001, the Under Secretary of Defense for Acquisition, Technology, and Logistics provided a Defense Advanced Research Projects Agency report on technology transitioning to congressional defense committees. The report provided Congress with the results of a review of the transition of research to the Military Departments from the Defense Advanced Research Projects Agency and addressed issues that were also applicable for the Air Force transition of research technology to acquisition program managers and, ultimately, to the warfighter. The report stated that a key reason for difficult technology transition was the need for collaboration among three diverse groups: the S&T researcher, the acquisition program manager, and the military user. Effective transition requires the groups to work together as a team, which is frequently a difficult issue. In addition, for a technology to transition successfully, the acquisition program manager's prime contractor must support the technology insertion, and the technology must demonstrate a greater return than the existing capability.

Air Force Process. In 1997, the Air Force Research Laboratory (AFRL) was created through the consolidation of four former Air Force laboratories and the Air Force Office of Scientific Research. The laboratory comprises nine directorates, each with different technology disciplines, located throughout the United States. In addition, the Air Force Office of Scientific Research manages national and international basic research. The nine technology directorates are responsible for exploratory technology development (applied

research) and advanced technology development research areas, as well as other research funded with non-AFRL funds. The subject of this audit was research projects funded with AFRL advanced technology development funds.

The AFRL Science and Technology Mission Area Strategic Plan for FYs 2002 through 2009 provide a roadmap for the future technologies. The objective of the S&T program is to provide the technical foundation for the Air Force. In addition, the AFRL Center Strategic Plan for FYs 2002 through 2009 established a core strategy objective to demonstrate and transition technology. To accomplish that objective, AFRL partnered with the Major Commands (MAJCOMs) to ensure that at least 50 percent of the AFRL advanced technology development funds are directed towards advanced technology demonstrations (ATDs) through FY 2009. Also, AFRL partners with the MAJCOMs and the Air Force Materiel Command product centers to ensure that 75 percent of the transition plans for ATDs are funded.

Objectives

The audit objective was to determine whether the Air Force was successful in transitioning advanced technology projects to military applications. Specifically, we determined whether the Air Force had established a process to successfully transition technology. We also evaluated management controls at AFRL as they relate to the audit objective. See Appendix A for a discussion of the audit scope and methodology, the review of the management control program, and prior coverage related to the audit objectives.

The audit examined 30 S&T projects (24 ATDs and 6 Critical Experiments (CEs)) funded from the advanced technology development budget subcategory of the FY 2003 Air Force research, development, test, and evaluation appropriation. The 30 S&T projects were valued at $123 million. The 30 S&T projects had additional planned funding of $222 million from FY 2004 through FY 2007. The audit examined whether working-level IPTs were established, whether they included the planned recipients, whether charters were established for the IPTs, whether official memorandums of understanding or agreement or technology transition plans had been established, and whether agreements included TRLs and exit criteria. The audit did not review exploratory research (applied research) or AFRL projects conducted with non-AFRL funding.

Air Force Science and Technology Process

In 2001, the Commander of the Air Force Materiel Command and the Principal Deputy Assistant Secretary of the Air Force (Acquisition and Management) established interim guidance for the Applied Technology Councils (ATCs) to facilitate the technology transition of advanced technology demonstrations to the warfighter. Although the ATCs created a General Officer and executive level of review for the ATDs and other management oversight processes, improvements in coordination are still needed in the AFRL at the acquisition program manager level. Specifically, although 23 technologies did have working-level IPTs, other critical elements for transitioning were missing:

- All but two working-level IPTs had not established charters to identify roles and responsibilities,
- Half of the ATDs had not established technology transition plans for emerging technologies,
- Most of the technologies did not have established agreements on TRLs and exit criteria with technology recipients,
- Twelve of the working-level IPTs did not document issues and action items to prevent development problems and provide accountability, and
- Eight of the 13 acquisition recipients for technologies scheduled to transition in FYs 2003 and 2004 did not identify funding.

In addition, the performance appraisal process for S&T officials needs improvement to emphasize technology transitioning as a performance element.

These conditions exist because Air Force S&T management had not fully implemented the best practices advocated by the Deputy Under Secretary of Defense for Science and Technology. The status of formal agreements between the technology and recipient communities is not a subject at the ATCs. The AFRL had not established a requirement for formal coordination on critical experiment (non-ATD) research with the planned technology recipient and also had not established minimum documentation standards for technology development to include minutes of IPTs, record of action items, and decisions. As a result, the AFRL planned technology investments of $222 million for technologies included in this review had not been fully coordinated with the transition recipient. In addition, the Air Force technology recipients had a $529 million transition-funding shortfall for all AFRL emerging technologies scheduled to transition from FYs 2003 through 2005.

Air Force Advance Technology Program

Air Force guidance for planning and managing S&T projects was created before the AFRL was established in 1997 and does not describe the current process used to plan and manage S&T efforts. Since 1997, the AFRL organizational structure and the Air Force S&T process have changed and, on June 13, 2003, the Secretary of the Air Force revised Air Force Policy Directive 61-1, Management of Science and Technology, which provides overarching S&T guidance to reflect those changes. The guidance updates the roles and responsibilities of all Air Force organizations directly involved in managing S&T. Three key components of the Air Force include the ATCs, baseline reviews, and the Acquisition Center of Excellence processes.

Applied Technology Councils. In 2001, the Commander, Air Force Materiel Command and the Principal Deputy Assistant Secretary of the Air Force (Acquisition and Management) established interim guidance for the ATCs. The ATCs were designed to establish a closer link between the AFRL; product, logistical, and test centers of the Air Force Materiel Command; and the MAJCOMs. The Air Force Materiel Command product centers identify required transition funding, prepare technology transition schedules for acquisition programs receiving ATD technologies, and recommend candidate ATD priorities.

The objective of the ATCs is to review and approve technology, and prioritize technology funding. The ATCs provide a senior-level forum to facilitate transition of technology from AFRL into advanced system developments and fielded system upgrades. In addition, the ATCs are to provide MAJCOM customer focus for development efforts in AFRL based on warfighter requirements to improve Air Force warfighting capabilities. The ATC process was established in November 1999.

Each ATC semiannually reviews the status of existing approved ATDs, approves (commissions) advancing S&T efforts as ATDs, and offers guidance to AFRL on future candidate ATD programs. The ATC process classifies ATDs in the following categories:

- Category 1: MAJCOM supports and has programmed required funding for transitioning to an acquisition effort within the Future Years Defense Plan.
- Category 2A: MAJCOM supports and is committed to identifying transition funding in the next budgeting cycle.
- Category 2B: MAJCOM supports but is not currently able to budget for the transition.
- Category 3: Warfighter does not support and has no plan to use the technology.

Baseline Reviews. In December 2001, the AFRL began baseline reviews as part of an internal management control process. Baseline reviews are conducted on ATDs and high visibility programs and establish agreements between AFRL technology directorates and AFRL Command Section officials on the developing technology. ATD baseline reviews are conducted semiannually to advise AFRL executive officials on the progress of the technology development efforts. Baseline reviews are intended to provide accountability on the cost, schedule, program, and risk for developing technologies. Also, baseline reviews ensure that resources remain committed to the research efforts, agreements with customers are met, and problems are identified early.

Acquisition Center of Excellence. In June 2002, the AFRL established the Acquisition Center of Excellence to increase the effectiveness of the AFRL functions, processes, and efforts. The mission of the Acquisition Center of Excellence program is to work in partnership with AFRL and customer organizations to increase the speed at which required, capable, and affordable technology transitions to the warfighter.

The initial goals of the Acquisition Center of Excellence are to improve the speed and ease the delivery of new technology capabilities into Air Force weapon systems, to define and implement a comprehensive framework for laboratory technology transitions, and to investigate strategic collaboration initiatives with industry. An Acquisition Center of Excellence vision includes the involvement of the technology customers on S&T program IPTs in developing the requirements and exit criteria and participating in key program decisions. The AFRL Acquisition Center of Excellence also adopted the Transformational Management for Accelerated Technology Transition process that applies systems engineering principles across AFRL research programs.

As part of the Acquisition Center of Excellence program, the AFRL initiated a management process called the Integrated Product and Process Development that strives to provide a disciplined systems engineering approach to enhance technology development and coordination. Integrated Product and Process Development involves thinking ahead and balancing performance, producibility, cost, schedule, and risk--all integral elements of the S&T effort.

Critical Experiments Guidance. CEs are advance technology development-funded efforts that have not been submitted to the ATCs as ATD proposals. Air Force guidance provides limited policy and procedures on managing CEs, even though these experiments represent about $380 million or 53 percent of the AFRL advanced technology development funding for FY 2003. Air Force Instruction 61-105, "Planning for Science and Technology," July 22, 1994, requires that the MAJCOMs review advanced development efforts for relevancy to future technology needs. The reviews include selected CEs and may prioritize the selected CEs based on future technology needs. The ATC process reviews only CEs that are candidates for ATDs.

Technology Development Guidance

The interim guidance issued by the Deputy Secretary of Defense states that S&T programs shall address user needs, maintain a broad-based program spanning all Defense-relevant sciences and technologies to anticipate future needs and those not being pursued by civil or commercial communities, preserve long-range research, and enable rapid successful transition from the S&T base to useful military products. The Handbook provides elements of best practices and procedures captured in the form of criteria for S&T managers. Those criteria were endorsed by the Deputy Under Secretary of Defense for Acquisition and Technology's Affordability Task Force that was charted by the Director for Defense Research and Engineering to develop solutions on how to strengthen DoD S&T programs.

Air Force Science and Technology Products Reviewed

The AFRL needs to strengthen its S&T coordination with program recipients. The Handbook and Guide recommend establishing memorandums of agreement or understanding with the acquisition program manager(s), including agreement on TRLs and exit criteria, to ensure that acquisition programs have the necessary funding for S&T integration. In addition, the AFRL should require S&T product managers to document IPT issues to prevent potential development problems resulting from key personnel changes.

The audit examined 30 S&T projects (24 ATDs and 6 CEs) funded from the advanced technology development budget subcategory of the FY 2003 Air Force research, development, test, and evaluation appropriation. The 30 S&T projects were valued at $123 million. The 30 S&T projects had additional planned funding of $222 million from FY 2004 through FY 2007. Twenty-two of the 24 ATDs (two completed ATDs transitioned to other ATDs) had 23 planned recipient acquisition programs and the 6 CEs had 6 planned recipients. The following table summarizes the audit results by ATD and CE, using the recommended best business practices in the Handbook and Guide.

Table 1. Science and Technology Advanced Technology Demonstrations and Critical Experiments Examined
(ratio shows positive responses to total examined)[1]

	Number of Occurrences		Percent of Occurrences[2]	
	24 ATDs	6 CEs	24 ATDs	6 CEs
IPTs at the product level				
Team established	19 of 22	4 of 6	86	67
Charter established	1 of 19[3]	1of 4[4]	5	25
Acquisition program manager included	19 of 20[5]	4 of 4	95	100
Acquisition program prime contractor included	18 of 19[3]	3 of 3[3]	95	100
Acquisition Program Manager				
MOA/MOU/TTP[6]	11 of 22	1 of 6	50	17
Exit TRLs formally agreed	7 of 23[5]	0 of 6	30	0
Exit criteria formally agreed	10 of 23[5]	1 of 6	43	17
Funding for FYs 2003 and 2004 transitions by the acquisition recipient	5 of 13[7]	0 of 0[7]	38	

Note: Appendix C provides the supporting detail to the table by ATD and CE.

[1]Draft documents were not considered a positive response. Response deemed "not applicable" were not included in the base.

[2]The percentage of occurrences represent the results of projects examined and may not necessarily represent the results of all projects in the AFRL advanced technology demonstration funded universe.

[3]Nineteen of the 24 ATDs reviewed had working-level IPTs. The base for the CEs was reduced by 1 because 1 project did not have an identified acquisition program contractor.

[4]Four of the six CEs had working-level IPTs.

[5]One technology had two identified users, therefore the base was increased by one.

[6]Memorandum of Agreement, Memorandum of Understanding, Technology Transition Plan.

[7]Twelve of the 24 ATDs had near-term transitions dates (One of the ATDs has two recipients, therefore the 12 is 13) . AFRL does not require CEs to have a transition path and therefore the CEs do not have an established scheduled to transition.

Integrated Product Teams

The Deputy Secretary of Defense issued interim acquisition guidance on October 30, 2002, which states that IPTs will be used and that they will include warfighters, users, developers, acquirers, technology experts, industry, testers, budgeting officials, and system maintainers. In addition, the Handbook and Guide cite best business practices, including establishment of working-level IPTs and IPT charters. To be effective, IPTs must include the acquisition program manager(s) and have an established charter. The prime contractor should also be considered for IPT participation, if appropriate, to facilitate the technology integration.

Integrated Product Teams Established. The Handbook and Guide recommended the establishment of IPTs at the working level for all the S&T efforts and ATDs. AFRL officials established working-level IPTs for 19 of the 22 ATDs and 4 of the 6 CEs. Nineteen of the 20 planned technology recipients were participating in the 19 working-level IPTs to some degree (1 technology had 2 planned recipients). Four of the six CEs had established a working-level IPT and all four CEs had participation by the planned recipient.

Integrated Product Team Charters. The Handbook recommends the establishment of IPT charters. The Handbook states that IPT charters provide the best way to minimize team misunderstanding. The Handbook provides that each charter should include:

- The mission and objectives of the team,
- The metrics to evaluate the team's progress,
- The scope of the team's responsibility,
- The relationship of the team with other teams,
- The authority and accountability of the team,
- The resources available for the team, and
- A team membership list.

Only 1 of the 19 ATDs and 1 of the 4 CEs had established some form of a charter for their IPTs. The AFRL process does not require the establishment of a charter, and AFRL officials stated that other required research supporting documentation for baseline and ATC reviews capture many of the elements that IPT charters would contain. However, our review identified a general lack of IPT documentation of meeting results, action items, and issues needing continued examination, posing a risk in orderly continuation of S&T efforts. This risk is avoidable by requiring the documentation of significant program decisions and development issues and providing for accountability. The AFRL does not require the establishment of IPT charters to document the roles and responsibilities of

AFRL or acquisition officials or require the establishment of a means to control and track issues, decisions, assignments, or action items resulting from IPT meetings. The lack of documentation also inhibits accountability.

Acquisition Program Prime Contractor. One goal of the Air Force S&T program is to transition technology to an acquisition program and, subsequently, to the warfighter. The Guide and Handbook recommend that the technology receiver's prime contractor participate in the IPT to facilitate the integration of the evolving technology into the receiving platform. Of the 19 ATDs that established IPTs, 18 planned recipients had prime contractors participating.

Of the four CEs that established IPTs, three recipient programs had prime contractors participating in the working-level IPT. The remaining CE technology recipient had not identified a prime contractor. Air Force had no official S&T guidance on prime contractor representation in IPTs for ATD or CE efforts.

Role of Acquisition Program Managers

To improve the likelihood of technology transition, acquisition program managers must make a firm commitment to transition the technology to their programs. The commitment should include a formal and up-to-date memorandum of agreement, understanding, or technology transition plan (TTP) between the S&T product manager and the acquisition program manager(s). Each memorandum should specify the relationships and responsibilities of the S&T product manager and the receiving acquisition program manager(s). The agreement should address system requirements, funding, personnel support, exit criteria, and TRLs. Within the AFRL, TTPs represent and function as the memorandum of agreement or understanding. TTPs represent agreement between the S&T and planned recipient communities on TRLs and exit criteria. Our review showed that TTPs do not always include agreement on TRLs and exit criteria. The AFRL draft guidance requires the establishment of TTPs that include agreement on TRLs and exit criteria. The establishment of TTPs that include TRLs and exit criteria is one of the subjects presented at the baseline reviews.

Technology Transition Plans. Air Force Materiel Command Instruction 61-102, "Technology Transition Planning," March 13, 1995, requires the development of TTPs. The instruction applies only to ATDs and states that TTPs will represent agreement between the AFRL and the receiving acquisition program manager(s) on the development of the technology for transitioning and the exit criteria. Eleven of the 22 ATDs had established TTPs. Of those 11 TTPs, 6 were current, 3 were being revised, and 2 had not been updated within the last 3 years (1 was 7 years old).

The six CEs had six planned recipients. Only one recipient had established a TTP and that TTP was 4 years old. AFRL does not require the establishment of TTPs for CEs. Although CEs are related to early stages of advanced technology development, the establishment of the substance of a TTP should be a requirement to ensure that the potential planned recipient is aware of the

technology effort and that some form of coordination and agreement on the technology's development, requirements, and exit criteria are established for a baseline for technology development.

Technology Readiness Levels. DoD adopted TRLs in response to a General Accounting Office Report, "Best Practices: Better Management of Technology Development Can Improve Weapon System Outcomes," issued in July 1999. A TRL is an assessment of the technical maturity of an S&T effort. In July 2001, the Deputy Under Secretary of Defense for Science and Technology issued a memorandum to the Military Departments and Defense agencies that emphasized the development of TRLs. The TRLs range from one through nine, with more mature S&T efforts having a higher TRL and a lower risk for the acquisition program. Only 7 of 23 recipients had agreed to TRLs. None of the six CEs had agreements on TRLs.

Exit Criteria. The exit criteria for each S&T effort describe the current capabilities, the expected performance parameters and conditions of measurement, the range of acceptable performance improvements, and the test conditions and verification methods for measuring performance. The S&T manager and the acquisition program managers, in collaboration with the IPT, develop exit criteria that are appropriate for transitioning the technology. The 22 ATDs had 23 technology recipients. Agreements on exit criteria were established for 10 of these 23 recipients. Of the six CEs, only one recipient had agreed to exit criteria.

Acquisition Program Funding

The DoD research, development, test, and evaluation budget is divided into seven budget activities. The S&T community receives funding from the first three budget activities only: basic research, applied research, and advanced technology development. The acquisition community is funded with three budget activities: demonstration and validation, engineering and manufacturing development, and operational systems development. A seventh budget activity, management support, is directed toward installations or operations required for general research and development use. This separation of research, development, test, and evaluation funding between the S&T and acquisition communities and the shrinking of the research, development, testing, and evaluation budget make coordination between the S&T program managers and acquisition program managers very critical.

Within the Air Force, the operational MAJCOMs prioritize the activity funds budgeted for the acquisition community. In this prioritization process, the MAJCOMs determine the funds planned for the technology transition from the S&T community to the acquisition community. As part of the review, we examined the transitioning fund requirements for the technologies reviewed in the audit and for the 47 technologies scheduled to transition between FYs 2003 and 2005 that are under development at AFRL. The review found significant technology transitioning funding shortfalls.

Funding for ATDs Reviewed. The MAJCOMs and acquisition program managers were not providing the funding required for technology transitioning. Twelve of the 22 ATDs were scheduled to transition to acquisition program managers in FYs 2003 or FY 2004. These 12 ATDs had 13 acquisition recipients. Of these 13, only 5 acquisition programs had identifiable funds for the transitioning technologies. Acquisition programs should be required to specifically identify funds, particularly for near-term transitions, to ensure that funds are available as a requirement for continued research expenditure by AFRL. Without adequate funding for technology transition, AFRL will not be able to determine whether continued investment in ATDs is beneficial or whether limited research funds of AFRL should be directed to other promising technology transition candidates.

Funding Requirements for All Near-Term Transitions. The AFRL plans to have 47 of the 62 ATDs ready for transitioning between FYs 2003 and 2005. The MAJCOMs identified a transition funding requirement of $2,406.8 million for 45 of 47 ATDs; however, only $1,877.4 million has been budgeted for FYs 2003 through 2007, resulting in a research, development, test, and evaluation shortfall of $529.4 million for FYs 2003 through 2007, if the technology development is successful. The MAJCOMS had not identified the funding requirements for the remaining two ATDs and only partially identified the funding requirements for 5 of the ATDs in Table 2. Table 2 shows the FYs 2003 through 2007 funding required, budgeted, and shortfalls for ATDs that are planned to become available in FYs 2003 through 2005.

Table 2. Summary of Near-Term ATD Categories By Technology Availability Year
(Dollars are in millions)

Fiscal Year of Technology Availability	Number of ATDs	[----------FYs 2003 - 2007----------] Funding Required	Funding Budgeted	Shortfall
2003	20	$1508.3	$1376.0	$132.3
2004	11	498.8	239.0	259.8
2005	14	399.7	262.4	137.3
Total	**45**	**$2,406.8**	**$1,877.4**	**$529.4**

Table 2 does not include transition funding that is embedded in the acquisition, such as preplanned product improvements.

In addition to the above, the Air Force also used Warfighter Rapid Acquisition Process (known as WRAP) funds to transition S&T efforts. Warfighter Rapid Acquisition Process funds were used to transition two ATDs in FYs 2002 and 2003. The Air Force had not budgeted for Warfighter Rapid Acquisition Process funds in the President's Budget for FY 2004 and subsequent years; therefore, this source of transition funds will not be available.

Personnel Performance Assessments

The AFRL established a performance element in the S&T Statements of Duties and Experience that addresses technology transitioning. The S&T duties state that the S&T official will seek opportunities for technology transitioning, lead or serve as a key technology member of teams for transitioning, and organize and market overall technology transitions at senior management levels. However, the S&T duties do not specifically include the requirements identified in the Handbook and Guide. For example, the AFRL S&T duties do not require the need for each S&T advanced technology development-funded effort to establish working-level IPTs with all planned recipients, to create IPT charters, to coordinate and agree upon quantitative metrics and key exit criteria with all planned recipients, to develop TTPs, and to develop and maintain up-to-date memorandums of agreement or understanding. The inclusion of these requirements in S&T duties would be a better measure of S&T personnel performance and would enhance the likelihood of technology transition.

Recommendations, Management Comments, and Audit Response

We recommend that the Commander, Air Force Research Laboratory:

1. Require the establishment of integrated product teams and charters for all advanced technology development efforts to include representatives from the Air Force Major Commands, the candidate acquisition program office(s), and the acquisition program office prime contractor(s), where applicable.

Management Comments. The Assistant Secretary of the Air Force (Acquisition) nonconcurred with the recommendation. The Assistant Secretary stated that integrated product teams (IPTs) and charters should not be required for all advanced technology development and that if the requirement was limited to advanced technology demonstration (ATD) programs, the Air Force would concur. He stated that non-advanced technology demonstration programs (known as Critical Experiments (CEs)) are not sufficiently technically mature for an objective evaluation by the potential receiver of the technology and that such a review would require a massive amount of resources because there are approximately 300 CEs compared to approximately 60 ATDs. The Assistant Secretary stated that IPTs are appropriate for ATDs and encourages IPTs for CEs; however, he believes that requiring IPTs for CEs would increase the AFRL workload five-fold.

The Assistant Secretary stated that AFRL had established a format for IPT charters.

Audit Response. The Assistant Secretary's comments are not fully responsive to the recommendation. The Assistant Secretary stated that he would concur with

this recommendation if it applied only to ATD programs because CEs are not sufficiently technically mature. We do not agree with the Air Force in making a distinction between ATDs and CEs because CEs are S&T projects that also use advanced technology development funds under the research, development, test, and evaluation appropriation, and, as such, should be held to a similar level of development coordination as ATDs. The DoD Financial Management Regulation, June 2002, defines advanced technology development under the research, development, test and evaluation appropriation as efforts that are proof of technological feasibility and assessment that have a direct relevance to identified military needs. CEs comprise 53 percent ($380 million) of the Air Force's advanced technology development budget for FY 2003 and should have specific, measurable, major technological advancements to be achieved. Projects under this category should be directly related to identified military needs, and should demonstrate their general military use. As such, early coordination with the potential recipient is necessary to ensure their military relevance and to enhance the transition of the CE technology.

Early coordination with potential recipients is emphasized not only in the Handbook and Guide, but also in the Defense Systems Management College training course, "Program Management for S&T Manager," STM 301, formally known as "Technology Insertion in Defense Systems Acquisitions." The Handbook, Guide, and the training course do not provide lesser coordination for any S&T effort that is funded by advanced technology development appropriations. With the emphasis on transitioning technology from the S&T to the potential recipient, we believe that the recommendation remains appropriate and has merit.

In preparing this report, we reviewed the AFRL ATD database and found two files that contained listings of CEs. The first file identified 107 CEs. Further examination of this CE file showed that 29 of the 107 CEs had the technology available in FY 2003 or before. Of the remaining 78 CEs, 27 were to have technology available during FYs 2004 or 2005: Accordingly, in the near-term, at least 27 CEs should be coordinated through IPTs with the planned technology receiver.

The second file provides another listing of 250 CEs by fiscal year, of which 129 were funded in FY 2003 and subsequent years, while another 25 were to begin funding in FY 2004. The remaining 96 CEs were either completed prior to FY 2003 or had no funding in FYs 2003 and 2004. This listing provides a funding profile for CEs only, and does not have a technology description.

We request the Assistant Secretary to reconsider his position and provide additional comments to the final report.

2. Establish procedures that require the status of technology transition plans between the science and technology manager, the Air Force Major Commands, and the candidate acquisition program offices be a subject of review at the Applied Technology Councils.

Management Comments. The Assistant Secretary concurred and stated that the AFRL established procedures, on June 23, 2003, requiring the Applied Technology Councils to review the status of technology transition plans. The procedures will be formalized in an Air Force instruction by March 2004.

3. Review the technology paths or plans for the eight unfunded science and technology efforts that are scheduled to transition in FYs 2003 and 2004, and discontinue development for those that do not have formal acquisition program support with identified funding.

Management Comments. The Assistant Secretary nonconcurred with the recommendation, citing that the ATC process was established with different technology categories to allow both technology push and pull. The technology balance of push and pull is required to maintain technological superiority. He said that eliminating developing technologies that do not have identifiable transition funding virtually eliminates the Air Force from maintaining and advancing a broad range of warfighting capabilities. The Assistant Secretary stated that certain technologies are developed but may not transition immediately, and that discontinuing the efforts would place the Air Force at risk. The Assistant Secretary stated that there have been many requests for immediate or timely technology capabilities where AFRL was able to provide previously developed solutions.

The Assistant Secretary provided the status of seven of the eight technologies included in the recommendation. The Assistant Secretary stated that the technology transition will be budgeted in FY 2006; the technology transitioned to another development effort; additional desired capabilities delayed the transition but the transition plan is in the approval stage; technology was complete but not funded for transition; technology is complete and unplanned Defense Emergency Response Funds were used to transition the technology; near-term transition remains unfunded but Warfighter Rapid Acquisition Program funds were being sought; and further development was needed before the planned receiver will seek transition funds. The eighth technology pertained to the Targets Under Trees, scheduled to transition to the Electronic Systems Center for which no comments were provided.

Audit Response. The Assistant Secretary's comments are nonresponsive. The intent of the recommendation was to address transitions that were scheduled for FYs 2003 and 2004. The Air Force needs to consider whether continued expenditure of ATD funds on technologies scheduled for near-term transition to acquisition programs is prudent if the necessary funds to continue the required development are not available. Although AFRL has no authority to compel program managers to identify transition funding, they do have the responsibility to review technology paths and plans for technology products to ensure viability, to identify whether the necessary transition funds are available, and to determine whether continued expenditure of ATD funds is appropriate when technology transitioning is questionable. One of the objectives of the ATC process was to ensure receiver funding sponsorship for transitioning. With limited S&T financial resources, it is prudent to align S&T efforts to technologies that are more likely to result in successful transitions.

The recommendation focused on developing technologies that were scheduled for transition in FYs 2003 and 2004. The key to transitioning technology is the availability of sufficient funds to mature the technology through later TRLs. Funds to mature and test the S&T efforts are needed; however, the budget cycle requires as much as 2 years of planning before funds are available. Therefore, AFRL and the planned receiver must agree early and prevent funding lapses during development. As indicated in the Assistant Secretary comments, at least half of those technologies remain unfunded or were provided to the warfighter only through unplanned emergency funding. Although the recommendation addressed only eight near-term technology transitions, the audit report identified that the AFRL is developing technologies that have a transitioning funding shortfall of at least $529 million if the technologies advance as planned. Many of those emerging technologies will fall into a waiting period where the technology is ready for transition but the planned recipient is unable to receive it because the recipient lacks transition funding. That waiting period could range from 2 years to a much longer period, depending upon the planned receiver's competing funding priorities.

We request the Assistant Secretary to reconsider his position and provide additional comments to the final report.

4. Issue guidance on critical experiments that require the establishment of memorandums of agreement or understanding, or technology transition plans, and the initial development of technology readiness levels and exit criteria.

Management Comments. The Assistant Secretary nonconcurred because the recommendation would "require" formal coordination with planned recipients. The Assistant Secretary stated that if the recommendation was reworded to "consider" the Air Force would concur. The Assistant Secretary also stated that AFRL is preparing an instruction for CEs that include most, if not all, of the recommendations as options and that establishing MOAs, MOUs, or TTPs as appropriate could be useful.

Audit Response. The Assistant Secretary's comments are nonresponsive to the recommendation. Critical experiments and ATDs are funded with advanced technology development funds under the research, development, test, and evaluation appropriation and comprise 53 percent ($380 million) of the Air Force's budget for FY 2003. The Handbook and Guide emphasize that successful transitions require commitment from all parties. Coordination and commitment are also stressed in the Defense Systems Management College training course, "Program Management for S&T Manager," STM 301. We believe that continued expenditure of large amounts of funds on CE technologies that do not have coordinated paths or plans for transitioning to acquisition programs ignores lessons learned and training on successful S&T transitioning. Successful transitioning requires coordination and funding considerations through formal agreements with planned technology recipients. The Assistant Secretary's comments do not address the intent of the recommendation because S&T managers were always encouraged to develop MOAs or MOUs, TTPs, TRLs, and exit criteria. Table 1 of this report shows that, despite the encouragement, only

one of the six CEs had established basic coordination agreements. Therefore, we still believe that advisory guidance is ineffective and the requirement to establish these agreements will enhance the likelihood of technology transitions as well as meet an identified military need. We request the Assistant Secretary to reconsider his position and provide additional comments to the final report.

5. Develop a process to coordinate critical experiment efforts with the Air Force Major Commands. This process should require the Air Force Major Commands' prioritization of and comments on applicable critical experiments for consideration by the Air Force Research Laboratory in determining whether to continue development.

Management Comments. The Assistant Secretary nonconcurred because the recommendation "required" coordination with planned recipients for CEs. The Assistant Secretary stated that coordination with planned recipients would be too manpower intensive and would be of marginal value in making investment decisions. The Assistant Secretary stated that information on CEs is available on the ATD database to which many Major Commands have access and that the AFRL portfolio is discussed during the Capabilities Requirements Review and Assessment process.

Audit Response. The Assistant Secretary's comments are nonresponsive. The Assistant Secretary believes there should be less coordination for CEs than for ATDs even though CEs compose 53 percent of the AFRL advanced technology development budget. The Office of the Under Secretary of Defense for Acquisition, Technology and Logistics issued the "Manager's Guide to Technology Transition in an Evolutionary Acquisition Environment," January 31, 2003. The Manager's Guide states that technology projects should be prioritized according to the warfighters' projected needs and reviewed by them periodically. S&T leaders, warfighters, and the acquisition or sustainment program manager should do the review annually, and projects should be funded according to the priorities established. As a means of encouraging new ideas, all programs should be evaluated for relevance and productivity. One way of encouraging ideas is to eliminate the least productive projects annually, which will keep the technology more current. The collaboration and coordination from early interaction and exchange between the technology and planned receiver communities permit experimenting with technology-driven operational issues and the early weeding out of unattainable technologies resulting in more focused requirements and capabilities.

Air Combat Command Prioritization. In August 2001, the Director of Requirements at Air Combat Command prioritized AFRL CEs to provide feedback on technology programs that were important to his command. The command's review and prioritization were the result of an action item at an Applied Technology Council meeting. In providing the prioritization to AFRL, the Director of Requirements stated that the AFRL should continue to work together with the command to ensure a common understanding of CE priorities. During that review, Air Combat Command personnel reviewed and ranked 121 CEs and did not comment on other CEs outside of the Command's interest. The Air Combat Command's request for review of CEs illustrates the importance

that one major command places on the review of emerging technologies and its attempt to influence AFRL investment decisions.

AFRL Database. Although the AFRL database has information on the CEs that could be used to identify the nature of the research, the database does not provide for prioritization and comment.

AFRL Portfolio. The Assistant Secretary stated that the AFRL portfolio is discussed during the Capabilities Requirements Review and Assessment process. The Capabilities Requirements Review and Assessment process examines capabilities in Global Strike, Homeland Security, Global Response, Global Mobility, Air and Space/Command, Control, Intelligence, Surveillance, and Reconnaissance. This process has recently been initiated and still is in development. It is unclear how this top-level review process will focus on individual CEs and prioritize them in relation to the overall concept of operations.

We continue to believe that the review and prioritization of CEs by planned recipients would provide valuable insight to AFRL in directing its efforts towards satisfying identified military needs. With planned-recipient endorsement of emerging CEs, the recipient can ensure that CE efforts are directly related to an identified military need and will more likely transition to the warfighter. Therefore, we request the Assistant Secretary to reconsider his position and provide additional comments to the final report.

6. Modify the Statements of Duties and Experience for science and technology personnel to emphasize the need for coordination with planned recipients. The Statements of Duties and Experience should specifically include the requirement for all advanced technology demonstration-funded efforts to establish working-level integrated product teams with all planned recipients, to create integrated product team charters, to coordinate and agree upon quantitative metrics and key exit criteria with all planned recipients, and to develop and maintain up-to-date memorandums of agreement or understanding, or technology transition plans.

Management Comments. The Assistant Secretary nonconcurred. He stated that S&T personnel work on a variety of projects in basic, applied research, and advanced technology development and that it is not appropriate to single out ATD-related work in the Statements of Duties and Experiences.

Audit Response. The Assistant Secretary's comments are nonresponsive and inconsistent with the guidance issued by OSD and comments provided by the Army and the Navy on a similar recommendation. As described in the Background section of this report, the DoD S&T Affordability Task Force issued a Handbook that stresses the importance of coordination between the research and technology recipient communities. The Handbook also states that one of the keys to successful transitioning is implementing an S&T personnel assessment process that is based on transitioning and affordability, in addition to individual technical achievements and publishing technical papers. Accelerating the flow of technology to the warfighter is one of the top priorities of the Under Secretary of Defense for Acquisition, Technology and Logistics. Linking technology

transitioning to S&T managers' performance would reinforce the DoD priority of enhancing the likelihood of providing advanced technologies to the warfighter.

We made a similar recommendation to the Army and Navy S&T officials in their respective technology transitioning reviews, and the Army and Navy officials concurred with the recommendation. Army and Navy S&T officials also manage basic and applied research efforts as well as advanced technology development. We request the Assistant Secretary to reconsider his position and provide additional management comments to the final report.

Appendix A. Scope and Methodology

Work Performed. We examined 30 S&T technologies at the AFRL, with FY 2003 funding of $123 million, to evaluate the management process for transitioning successful technologies to the warfighter. The S&T technologies examined were funded with the advanced technology development budget activity within the Air Force research, development, test and evaluation appropriation. The 30 projects were judgmentally selected, were currently funded, were planned near term transitions, were high dollar value budgeted projects, and were from 6 of the 8 AFRL Directorates that conduct ATD research projects. The FY 2003 Appropriation Bill provided about $718 million in Air Force advanced technology development funding. The FY 2003 budget provided funding for 62 ATDs, 129 CEs, and additional congressional interest items valued at $170 million.

We conducted interviews with S&T and acquisition program officials, and examined applicable key documentation. Key documentation included guidance advocated by the Deputy Under Secretary of Defense for Science and Technology; technology transition plans; working-level IPT meeting minutes where available; memorandums of understanding and agreement; acquisition program funding profiles; S&T management plans; technology transition paths or plans; and the research, development, test, and evaluation budget item justification sheet (R-2 Exhibit).

We performed this audit from September 2002 through August 2003 in accordance with generally accepted government auditing standards. We did not evaluate the technical merits of the S&T products. We limited the AFRL management control review to the S&T management procedures and the departments responsible for transitioning technology from the S&T community to the acquisition program managers or another technology area.

Use of Computer-Processed Data. We relied on computer-processed data without performing tests of general and application system controls to confirm the reliability of the data. We relied on the Department of the Air Force Research Laboratory Advanced Technology Demonstration (ATD) database, https://techsql.afrl.af.mil/atd/default.asp and a computerized listing of ATDs and CEs to represent the known universe of S&T products in the review of the management process. We validated the total funding for FY 2003 on the computerized listing to the total funding under the advanced technology development budget activity within the Air Force research, development, test, and evaluation appropriation. Validating the computerized listing to the appropriations was appropriate for this audit because the audit's objective was to examine the overall management process for technology transitioning, not the individual S&T products. Further validation of the computerized listing would not change the conclusions in this report.

General Accounting Office High-Risk Area. The General Accounting Office has identified several high-risk areas in the DoD. This report provides coverage of the Weapon System Acquisition high-risk area.

Management Control Program Review

DoD Directive 5010.38, "Management Control (MC) Program," August 26, 1996, and DoD Instruction 5010.40, "Management Control (MC) Program Procedures," August 28, 1996, require DoD organizations to implement a comprehensive system of management controls that provides reasonable assurance that programs are operating as intended and to evaluate the adequacy of the controls.

Scope of the Review of the Management Control Program. We reviewed the adequacy of AFRL management controls over technology transition. Specifically we reviewed AFRL management controls over the transition of science and technology projects funded with research, development, test, and evaluation funds; advanced technology development appropriations. Because we did not identify a material control weakness, we did not assess management's self-evaluation because adequate management processes such as the ATC and baseline reviews provide a mechanism for management controls. .

Adequacy of Management Controls. The audit identified that the Air Force had established adequate controls over technology transition that included a high-level management oversight process to approve and review proposed and ongoing technologies.

Prior Coverage

During the last 5 years, the GAO has issued one report and the Inspector General of the Department of Defense (IG DoD) has issued three reports discussing the benefits of adequately managing the challenges of transitioning technologies to warfighters.

GAO

Report No. NSIAD-99-162, "Best Practices: Better Management of Technology Development Can Improve Weapon System Outcomes," July 30, 1999

IG DoD

IG DoD Report No. D-2003-053, "Navy Transition of Advanced Technology Programs to Military Applications," February 4, 2003

IG DoD Report No. D-2002-146, "The Defense Advanced Research Projects Agency's Transition of Advanced Information Technology Programs," September 11, 2002

IG DoD Report No. D-2002-107, "Army Transition of Advanced Technology Programs to Military Applications," June 14, 2002

Appendix B. Technology Readiness Levels and Their Definitions

The Deputy Secretary of Defense issued interim acquisition guidance on October 30, 2002. The interim guidance provided a matrix that lists technology readiness levels and descriptions from a systems approach for both hardware and software as shown below.

Technology Readiness Level	Description
1. Basic principles observed and reported.	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development. Examples might include paper studies of a technology's basic properties.
2. Technology concept and/or application formulated.	Invention begins. Once basic principles are observed, practical applications can be invented. The applications are speculative and there may be no proof or detailed analysis to support the assumptions. Examples are limited to analytic paper studies.
3. Analytical and experimental critical function and/or characteristic proof of concept.	Active research and development is initiated. This includes analytical studies and laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.
4. Component and/or breadboard validation in laboratory environment.	Basic technological components are integrated to establish that they will work together. This is relatively "low fidelity" compared to the eventual system. Examples include integration of "ad hoc" hardware in a laboratory.
5. Component and/or breadboard validation in relevant environment.	Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so it can be tested in simulated environment. Examples include "high fidelity" laboratory integration of components.
6. System/subsystem model or prototype demonstration in a relevant environment.	Representative model or prototype system, which is well beyond that of TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high fidelity laboratory environment or in a simulated operational environment.
7. System prototype demonstration in an operational environment.	Prototype near, or at, planned operational system. Represents a major step up from TRL 6, requiring the demonstration of an actual system prototype in an operational environment such as an aircraft, vehicle, or space. Examples include testing the prototype in a test bed aircraft.
8. Actual system completed and qualified through test and demonstration.	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental test and evaluation of the system in its intended weapon system to determine if it meets design specifications.
9. Actual system proven through successful mission operations.	Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation. Examples include using the system under operational mission conditions.

Appendix C. Summary of Advanced Technology Development Projects Reviewed

Advanced Technology Demonstrations

System	Receiving Acquisition Program	MOA/ MOU/ TTP[1] With User	Established an IPT[2]	IPT[2] Charter	IPT[2] Includes Acquisition User	IPT[2] Includes Acquisition Prime Contractor	Funding By Acquisition User to Transition[3]	Acquisition User Agreed to TRL[4]	Acquisition User Agreed to Exit Criteria
Advanced Laser Eye Protection (ALEP)	311th Human Systems Wing (311 HSW)	Yes	Yes	No	Yes	Yes	Yes (Cat 1) (FY03)	No	Yes
Cognitive Desktop Information Manager (CDIM)	Electronic Systems Center (ESC)	n/a[9]	n/a[9]	n/a[9]	n/a[9]	n/a[9]	n/a[9]	n/a[9]	n/a[9]
Common Situation Awareness (CSA)	Aeronautical Systems Center (ASC)	No	Yes	No	Yes	Yes	n/a[10] (Cat 1)	No	No
Day/Night EO/IR Threat Tracker Countermeasure	Aeronautical Systems Center (ASC)	No	No	n/a[6]	n/a[6]	n/a[6]	n/a[10] (Cat 2A)	No	No
Distributed Analysis Decision Support System (DADSS)	Electronic Systems Center (ESC)	n/a[9]	n/a[9]	n/a[9]	n/a[9]	n/a[9]	n/a[9]	n/a[9]	n/a[9]
Effects Based Operations (EBO)	Electronic Systems Center (ESC)	Draft[5]	Yes	No	Yes	Yes	No (Cat 2A) (FY 04)	No	No

Note: See footnotes at the end of the appendix.

Advanced Technology Demonstrations (cont'd)

System	Receiving Acquisition Program	MOA/ MOU/ TTP[1] With User	Established an IPT[2]	IPT[2] Charter	IPT[2] Includes Acquisition User	IPT[2] Includes Acquisition Prime Contractor	Funding By Acquisition User to Transition[3]	Acquisition User Agreed to TRL[4]	Acquisition User Agreed to Exit Criteria
Enhanced Rotor Life Extension (ERLE) Spiral I	Oklahoma City Air Logistics Center (OC-ALC)	Yes	Yes	No	Yes	Yes	n/a[10] (Cat 1)	No	No
Expeditionary Air Ground Equipment (EAGE)	Warner Robbins Air Logistics Center (WR-ALC)	Draft[5]	No	n/a[6]	n/a[6]	n/a[6]	n/a[7]	No	No
F35 F136	Aeronautical Systems Center (ASC)	Draft[5]	Yes	No	Yes	Yes	n/a[10]	No	No
Foliage Penetration Synthetic Aperture Radar (FOPEN)	Aeronautical Systems Center (ASC)	Draft[5]	Yes	Yes	Yes	Yes	No (Cat 2B) (FY03)	No	No
Future Air Navigation and Traffic Avoidance Solution Through Integrated Communication, Navigation & Surveillance (CNS) (FANTASTIC)	Electronic Systems Center (ESC)	No	No	n/a[6]	n/a[6]	n/a[6]	n/a[7]	No	No

Note: See footnotes at the end of the appendix.

Advanced Technology Demonstrations (cont'd)

System	Receiving Acquisition Program	MOA/ MOU/ TTP[1] With User	Established an IPT[2]	IPT[2] Charter	IPT[2] Includes Acquisition User	IPT[2] Includes Acquisition Prime Contractor	Funding By Acquisition User to Transition[3]	Acquisition User Agreed to TRL[4]	Acquisition User Agreed to Exit Criteria
Fuze Air-to-Surface Technology (FAST)	Air Armaments Center (AAC)	Yes	Yes	No	Yes	Yes	n/a[10] (Cat 2B)	Yes	Yes
Global Air Mobility Advanced Technologies (GAMAT)	Air Mobility Command (AMC)	Draft[5]	Yes	No	Yes	n/a[8]	No (Cat 2A) (FY03)	No	No
Information for Global Reach (IFGR)	Electronic Systems Center (ESC)	Draft[5]	Yes	No	Yes	Yes	n/a[10] (Cat 2B)	No	No
Integrated Flight Management (IFM)	Electronic Systems Center (ESC)	Draft[5]	Yes	No	Yes	Yes	Yes (Cat 1) (FY03)	No	No
Integrated Panoramic Night Vision Goggles (IPNVG)	Aeronautical Systems Center (ASC)	Yes	Yes	No	Yes	Yes	Yes (Cat 1) (FY03)	Yes	Yes
Laser Infrared Flyout Experiment (LIFE)	Aeronautical Systems Center (ASC)	Yes	Yes	No	Yes	Yes	Yes (Cat 1) (FY04)	No	yes

Note: See footnotes at the end of the appendix.

Advanced Technology Demonstrations (cont'd)

System	Receiving Acquisition Program	MOA/ MOU/ TTP[1] With User	Established an IPT[2]	IPT[2] Charter	IPT[2] Includes Acquisition User	IPT[2] Includes Acquisition Prime Contractor	Funding By Acquisition User to Transition[3]	Acquisition User Agreed to TRL[4]	Acquisition User Agreed to Exit Criteria
Multiple Event Hard Target Fuze (MEHTF)	Air Armaments Center (AAC)	Yes	Yes	No	Yes	Yes	No (Cat 2B) (FY02)	Yes	Yes
Powered Low-Cost Autonomous Attack System (P-LOCAAS)	Air Armaments Center (AAC)	Yes	Yes	No	Yes	Yes	n/a[10] (Cat 2B)	Yes	Yes
Precision Direct Attack Munition (PDAM)	Air Armaments Center (AAC)	Yes	Yes	No	Yes	Yes	Yes (Cat 1) (FY03)	Yes	Yes
Situational Awareness from Enhanced Threat Information (SAFETI)	Aeronautical Systems Center (ASC)	Yes	Yes	No	Yes	Yes	n/a[7]	No	Yes
Surface Target Ordnance Package (STOP)	Air Armaments Center (AAC)	Yes	Yes	No	Yes	Yes	No (Cat 2A) (FY02)	Yes	Yes

Note: See footnotes at the end of the appendix.

Advanced Technology Demonstrations (cont'd)

System	Receiving Acquisition Program	MOA/ MOU/ TTP[1] With User	Established an IPT[2]	IPT[2] Charter	IPT[2] Includes Acquisition User	IPT[2] Includes Acquisition Prime Contractor	Funding By Acquisition User to Transition[3]	Acquisition User Agreed to TRL[4]	Acquisition User Agreed to Exit Criteria
Strike Helmet 21 Technologies (SH21)	Aeronautical Systems Center (ASC)	Yes	Yes	No	Yes	Yes	No (Cat 2A) (FY04)	Yes	Yes
Targets Under Trees (TUT)	Aeronautical Systems Center (ASC)	Draft[5]	Yes	Draft[5]	Yes	Yes	No (Cat 2B) (FY04)	No	No
Targets Under Trees (TUT) (cont'd)	Electronic Systems Center (ESC)	Draft[5]	Yes	Draft[5]	No	No	No (Cat 2B) (FY04)	No	No

Note: See footnotes at the end of the appendix.

Critical Experiments

System	Receiving Acquisition Program	MOA/ MOU/ TTP[1] With User	Established an IPT[2]	IPT[2] Charter	IPT[2] Includes Acquisition User	IPT[2] Includes Acquisition Prime Contractor	Funding By Acquisition User to Transition[3]	Acquisition User Agreed to TRL[4]	Acquisition User Agreed to Exit Criteria
High Speed Penetrator with Precision Fuzing (HSP)	Air Armaments Center (AAC)	No	No	n/a[6]	n/a[6]	n/a[6]	n/a[10]	No	No
Hyperspectral Information Fusion (HSIF)	Electronic Systems Center (ESC)	No	Yes	No	Yes	Yes	n/a[10]	No	No
Joint Battlespace Infosphere (JBI)	Electronic Systems Center (ESC)	No	Yes	No	Yes	n/a[8]	n/a[10]	No	No
Multi Intelligence Fusion for Time Critical Targeting	Electronic Systems Center (ESC)	No	No	n/a[6]	n/a[6]	n/a[6]	n/a[10]	No	No
Nighttime Agile Laser Eye Protection (NALEP)	(not commissioned)	No	Yes	No	Yes	Yes	n/a[10]	No	No
Programmable Integrated Ordnance Suite (PIOS)	Air Armaments Center (AAC)	Yes	Yes	Yes	Yes	Yes	n/a[10]	No	Yes

Note: See footnotes at the end of the appendix.

[1] Memorandum of Agreement; Memorandum of Understanding; Technology Transition Plan
[2] Integrated Product Team
[3] The notation of "no" indicates that transition funding for the emerging technology was not specifically identifiable in budget documentation at the respective program office.
[4] Technology Readiness Level
[5] Draft documentation was not counted as a positive response.
[6] Not applicable because no IPT was created for this program.
[7] Not applicable because this technology was completed at AFRL prior to FY03.
[8] Not applicable because there is no acquisition prime contractor for this program.
[9] Due to a transition within AFRL, this technology required no coordination. As such, all data points are not applicable.
[10] Not applicable because budgets for FY05 and beyond were not formalized at the time of the audit.

Appendix D. Report Distribution

Office of the Secretary of Defense

Under Secretary of Defense for Acquisition, Technology, and Logistics
    Deputy Under Secretary of Defense for Advanced Systems and Concepts
Under Secretary of Defense (Comptroller)/Chief Financial Officer
    Deputy Chief Financial Officer
    Deputy Comptroller (Program/Budget)

Department of the Air Force

Assistant Secretary of the Air Force for Acquisition
Assistant Secretary of the Air Force (Financial Management and Comptroller)
Commander, Air Force Materiel Command
    Commander, Aeronautical Systems Center
    Commander, Electronic Systems Center
    Commander, Air Force Research Laboratory
    Commander, Air Armament Center
Commander, Air Combat Command
Commander, Air Force Special Operations Command
Commander, Air Force Command and Control and Intelligence, Surveillance, and
    Reconnaissance Center
Commander, Air Mobility Command
Auditor General, Department of the Air Force

Non-Defense Federal Organization

Office of Management and Budget

Congressional Committees and Subcommittees, Chairman and Ranking Minority Member

Senate Committee on Appropriations
Senate Subcommittee on Defense, Committee on Appropriations
Senate Committee on Armed Services
Senate Committee on Governmental Affairs
House Committee on Appropriations
House Subcommittee on Defense, Committee on Appropriations
House Committee on Armed Services
House Committee on Government Reform
House Subcommittee on Government Efficiency and Financial Management, Committee on Government Reform
House Subcommittee on National Security, Emerging Threats, and International Relations, Committee on Government Reform
House Subcommittee on Technology, Information Policy, Intergovernmental Relations, and the Census, Committee on Government Reform

Department of the Air Force Comments

Final Report Reference

DEPARTMENT OF THE AIR FORCE
WASHINGTON DC

Office Of The Assistant Secretary

25 JUL 2003

MEMORANDUM FOR UNDER ASSISTANT INSPECTOR GENERAL FOR AUDITING
OFFICE OF THE INSPECTOR GENERAL DEPARTMENT OF DEFENSE

FROM: Assistant Secretary of the Air Force (Acquisition) - SAF/AQ
1060 Air Force Pentagon
Washington, DC 20330-1060

SUBJECT: Draft "Air Force Transition of Advanced Technology Programs to Military Applications," Project No. D2002AB-0128, dated 2 June 2003.

Ref: (a) DoDIG Memo of 2 Jun 2003

This is in reply to your memorandum (ref (a)) requesting the Assistant Secretary of the Air Force (Financial Management and Comptroller) provide Air Force Comments on the subject report. The attachment provides Assistant Secretary of the Air Force (Acquisition) concurrence or non-concurrence with each recommendation, and comments as you requested.

The report analyzes management indicators that have been suggested as best practices which continue to evolve, but are not mandatory. The Air Force is pleased that the audit identified that the Air Force had established adequate management controls over technology transition via the Applied Technology Council and the Program Baseline Reviews.

The Air Force agrees with the audit concerning the role of the acquisition program managers supporting Integrated Product Teams, citing the necessity for defining the relationships and responsibilities between the Science and Technology program manager and the acquisition program manager.

The Air Force does not agree that all advanced technology development efforts need the same level of management controls and therefore makes a distinction between Advanced Technology Demonstration programs and Critical Experiments.

MARVIN R. SAMBUR
Assistant Secretary of the Air Force
(Acquisition)

Attachment:
Air Force Response to DoD(IG) Draft Report D2002AB-0128

Final Report Reference

Air Force Response to DoD(IG) Draft Report D2002AB-0128

1. **Recommendations and Responses:** The subject report provides six recommendations. These recommendations are listed below with Air Force responses.

a. Recommendation: **Require the establishment of integrated product teams and charters for all advanced technology development efforts to include representatives from the Air Force Major Commands, the candidate acquisition program offices(s), and the acquisition program office prime contractor(s), where possible.**

Response: Air Force nonconcurs with the recommendation to include all advanced technology development efforts in an Integrated Product Team (IPT) type activity. However, if the phrase, "advanced technology development efforts," is changed to "Advanced Technology Demonstration programs," the Air Force would concur with this recommendation.

Non-Advanced Technology Demonstration 6.3 programs, otherwise known as Critical Experiments (CEs), are not sufficiently technically mature for an objective evaluation by Major Commands (MAJCOMs) or acquisition program offices to determine warfighter utility. Additionally, to do a 100 percent evaluation of the 6.3 program would require a massive amount of resources that are not available for this type of activity. Therefore, IPTs are not appropriate for all Advanced Technology Development efforts, specifically CE efforts. The Air Force requires the establishment of IPTs for all Advanced Technology Demonstration (ATD) programs (approximately 50 percent of the Advanced Technology Development funding) and encourages the consideration of IPTs for CEs but does not require them. Requiring IPTs for CEs (approximately 300 CEs compared to approximately 60 ATDs) would significantly increase (approximately five-fold) the manpower needed by Air Force Research Laboratory (AFRL), acquisition program offices, and MAJCOMs to implement this recommendation.

For the three ATDs cited as not having IPTs:

- Two ATDs were completed in FY 01. There is no IPT required for closed ATDs.
- The third ATD, Day/Night EO/IR Threat Tracker Countermeasure, was commissioned in early CY 02 with a strawman IPT (Mar 02), but there was a contract issue that was not resolved until Mar 03. The IPT began work in Jun 03.

Air Force has formalized its efforts for establishing IPT charters. The AFRL has established a format to facilitate IPT charter establishment.

b. Recommendation: **Establish procedures that require the status of technology transition plans between the science and technology manager, the Air Force Major Commands, and the candidate acquisition program offices be a subject of review at the Applied Technology Councils.**

Response: Air Force concurs with this recommendation.

- AFRL implemented this recommendation on 23 Jun 03.

Att-1

- The Air Force will formalize this process in Air Force Instruction (AFI) 61-101 which is being revised. Estimated completion in Mar 04.

c. Recommendation: **Review the technology paths or plans for the eight unfunded science and technology efforts that are scheduled to transition in FYs 2003 and 2004, and discontinue development for those that do not have formal acquisition program support with identified funding.**

Response: Air Force nonconcurs with the recommendation to "discontinue development" of ATDs that do not have formal acquisition program support with identified funding. The Applied Technology Council (ATC) process was established with different ATD categories to allow both technology push by the technologists and technology pull by the MAJCOMs and acquisition program managers. A balance between technology push and technology pull is required to maintain technological superiority. Eliminating Category 2A (MAJCOM support, funding pending) and 2B (MAJCOM support, no funding) ATDs virtually eliminates the Air Force from maintaining and advancing a broad range of superior warfighting capabilities. Note: Air Force ATD Categories are summarized on page 5 of the report.

As an example, certain technologies are developed, but may not be able to transition immediately. Discontinuing these activities places Air Force research efforts at risk. In the past, there have been many requests for immediate or timely technology capabilities where AFRL was able to provide previously developed solutions. One such item is Next Generation Transparency. If AFRL had stopped the program because of no identifiable transition path, these technologies would not have been available as immediate solutions for T-38 and F-22 problems.

Seven of the eight ATDs of concern were reviewed - four were in Category 2A and three were in Category 2B. The eighth ATD (last entry on page 23 of the report) was inadequately identified to allow for a review. For the seven ATDs reviewed, all had or have sufficient funding to complete the S&T efforts.

- Effects Based Operations (Cat 2A): Air Combat Command (ACC) is working with the Electronic Systems Center (ESC) for inclusion of this transition in the FY 06 POM. Additionally, Warfighter Rapid Acquisition Program funds are being sought to transition this technology. Estimated Completion: 1st Qtr, FY 04.

- Foliage Penetration Synthetic Aperture Radar (FOPEN, Cat 2B): ATD was decommissioned and efforts were transitioned to the Target Under Trees (TUT) ATD. No further action.

- Global Air Mobility Advanced Technologies (GAMAT, Cat 2A): At the request of the user, the program scope is being expanded to provide additional capability, which will delay the estimated completion date. Additionally, transition of this ATD has been funded, resulting in an elevation to Category 1. This is a software transition that will be done directly by Air Mobility Command (AMC). A transition plan is in the approval stages with an estimated completion in the 1st Qtr, FY 04.

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- Multiple Event Hard Target Fuse (MEHTF, Cat 2B): ATD activities were completed in FY 02. Air Armament Center (AAC) desires this technology, but has not identified transition funding. This technology will be used in the High Speed Penetrator CE.

- Surface Target Ordnance Package (STOP, Cat 2A): ATD activities were completed and transitioned by AAC to an acquisition program in FY 02. Defense Emergency Response Funds produced weapon based on this technology in an accelerated program for Operations Iraqi Freedom. No further action required.

- Strike Helmet 21 Technologies (SH21, Cat 2A): Category was changed to 2B, since the Aeronautical Systems Center (ASC) F-15 System Program Office was unable to fund this transition in the short term due to competing priorities. ASC still desires this technology. Additionally, Warfighter Rapid Acquisition Program funds are being sought to transition this technology. ATD will be monitored by the ATC and should be completed in 4th Qtr, FY 05.

- Targets Under Trees (TUT, Cat 2B): The 2000 Air Force S&T Summit directed funding to be shifted to this effort. A portion of the technology, the radar, should be completed in FY 04, but further concept development in hyperspectral imaging is needed to make this technology more robust. ASC desires this technology, but is waiting for further developments before seeking transition funding. This has been a special interest item for the last two Air Force Chiefs of Staff. ATD will be reevaluate in FY 04 through the ATC process.

d. Recommendation: **Issue guidance on critical experiments that require the establishment of memorandums of agreement or of understanding, or technology transition plans, and the initial development of technology readiness levels and exit criteria.**

Response: Air Force nonconcurs with this recommendation due to the "requirement" to establish Memorandums of Agreement (MOAs) or Memorandums of Understanding (MOUs), or Technology Transition Plans (TTPs). Establishing exit criteria for CEs is part of managing an Advanced Technology Development program. If the phrase, "require," is changed to "consider," the Air Force would concur.

AFRL is drafting an instruction for CEs that will include most, if not all, of the recommendations as options. Establishing MOAs, MOUs, or TTPs, as appropriate, could be useful in managing selected CE programs. Estimated completion date: 1 Jul 04.

e. Recommendation: **Develop a process to coordinate critical experiment efforts with the Air Force Major Commands. This process should require the Air Force Major Commands' prioritization of and comments on applicable critical experiments for consideration by the Air Force Research Laboratory in determining whether to continue development.**

Response: Air Force nonconcurs with this recommendation due to the specification to "require" MAJCOMs to prioritize or comment on applicable CEs. In some circumstances it would be appropriate to get MAJCOM input on planned CEs, but it is

not appropriate to require MAJCOMs to prioritize applicable CEs. This is too manpower intensive and the product would be of marginal value in making program investment strategy decisions.

While MAJCOMs are made aware of CEs, they are not required to prioritize or comment on all CEs. AFRL has already begun to develop a process to coordinate CEs with the MAJCOMs. Information about all CEs is currently available on the ATD database to which many MAJCOM personnel have access. The AFRL portfolio is being discussed during the Capabilities Requirements Review and Assessment process in terms of how technologies can fill AF capability gaps. Estimated completion date: 1 Jul 05.

f. Recommendation: **Modify the Statements of Duties and Experience for science and technology personnel to emphasize the need for coordination with planned recipients. The Statement of Duties and Experience should specifically include the requirement for all advanced technology demonstration-funded efforts to establish working-level integrated product teams with all planned recipients, to create integrated product team charters, to coordinate and agree upon quantitative metrics and key exit criteria with all planned recipients, and to develop and maintain up-to-date memorandums of agreement or of understanding, or technology transition plans.**

Response: Air Force nonconcurs with this recommendation to modify the Statements of Duties and Experiences (SDEs) for science and technology personnel.

Science and Technology personnel work on a variety of different projects such as basic research, applied research, critical experiments and advanced technology demonstrations. It is not appropriate to single out advanced technology demonstration related work in the SDE.

2. **Other Modifications:** In addition to the Air Force responses to the six recommendations, the following modifications are recommended:

a. Page 1, "Defense Acquisition" Section, 1st paragraph, line 2: Change text to read "October 30, 2002 **(finalized on 12 May 2003),** which …".
   - Reason: The "interim guidance" from the Deputy Secretary of Defense was finalized on 12 May 03. The report should be updated to reference the final DoD Directive.

b. Page 2, "Air Force Process" Section, 1st paragraph, line 7 and Page 3, "Objectives" Section, 2nd paragraph, line 10: The budget category 6.2 is mislabeled as "exploratory technology development" and "exploratory research." The phrases should be changed to "Applied Research."
   - Reason: Correct terminology.

c. Page 5, "Air Force Advance Technology Program" Section, 1st paragraph, lines 3-5: The sentences starting with "Since 1997, …" should be replaced with "Since 1997, the AFRL organizational structure and the Air Force S&T process has changed and the Air Force **revised its** S&T guidance to reflect those changes. **The Air Force**

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Policy Document 61-1 (completed on 13 June 2003) updates the roles and responsibilities of all AF organizations directly involved in managing AF S&T."

- Reason: The "draft guidance" listed was a revision to the Air Force Policy Directive 61-1 which was finalized on 13 June 03.

d. Page 12, "Funding Requirements for All Near-Term Transitions" Section, 1st paragraph, lines 2-6: Add two sentences after the line 6 sentence that ends with "… FYs 2003 through 2007. " These sentences should read, "**This assumes that all ATDs are successful. (Note: Air Force has indicated that some ATDs, although based on potentially useful technology, were not successful.)**"

- Reason: The discussion of potential budget shortfalls for transition of ATDs assumes that all ATDs will be 100% successful. There is no guarantee of success for any Science and Technology program and, therefore, it is unnecessary to include 100% of the projected funding needed to transition all ATDs.

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e. Page 19, Appendix C, second and sixth entries: Delete these entries.

- Reason: Two of the ATDs listed have no data (all data points listed as "not applicable"). As such, these entries provide no useful data.

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f. Page 21, Appendix C, "Laser Infrared Flyout Experiment (LIFE)" entry: In the "Acquisition User Agreed to Exit Criteria" column, change "no" to "yes." If modified, the ratio should be **10 of 23** in Table 1 "Exit criteria formally agreed" (page 8) and the "Exit Criteria" section (page 11) of the report.

- Reason: A signed Technology Transition Plan (TTP) does exist, with signatures by all parties between Aug through Oct 96, along with a detailed annex, which includes all of the technical performance measures needed to indicate exit criteria. ATD was changed from LAIRCM to LIFE. The TTP, which refers to LAIRCM, was provided with an explanation to the DoDIG Team. While schedule, cost and methods of demonstration have changed since the TTP was signed, the exit criteria have not. In addition, the same IPT that created the CY 1996 TTP is still together and continues to agree on all aspects of exit criteria through all program evolutions.

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g. Page 22, Appendix C, P-LOCAAS entry: Change the entry in the "Acquisition User Agreed to TRL" entry to read "yes." If modified, the ratio should be **7 of 23** in Table 1 "Exit TRLs formally agreed" (page 8) and the "Technology Readiness Levels" section (page 11) of the report.

- Reason: The TTP was generated prior to establishment of TRLs. The TTP describes activities that lead to a TRL 6.

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h. Page 22, Appendix C, "Surface Target Ordnance Package (STOP)" entry: Changed the entry in the "Funding By Acquisition User to Transition" column to read "yes." If modified, the ratio should be **6 of 13** in Table 1 "Funding for FYs 2003 and 2004 transitions by the acquisition recipient" (page 8) and the "Funding for ATDs Reviewed" section (page 12) of the report.

- Reason: This effort has transitioned and the product is already in the Air Force inventory.

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